

## Delia J Milliron

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### **Education:**

**University of California, Berkeley:** Ph.D. in Physical Chemistry, 2004.

Thesis title: New materials for nanocrystal solar cells

Advisor: A. Paul Alivisatos

**Princeton University:** A.B., *summa cum laude*, in Chemistry, Certificate in Materials Science and Engineering, 1999.

Thesis title: Charge injection and chemistry at the indium tin oxide-organic interface

Advisors: Jeffrey Schwartz, Antoine Kahn

### **Employment:**

2012 – :	Deputy Director, The Molecular Foundry, LBNL, Berkeley, California
2008 – :	Staff Scientist, Materials Sciences Division, LBNL, Berkeley, California
2008 – 2012:	Director, Inorganic Nanostructures Facility, LBNL, Berkeley, California
2005 – 2008:	Research Staff Member, IBM Almaden Research Center, San Jose, California
2004 – 2005:	Postdoctoral Researcher, IBM Watson Research Center, Yorktown Heights, New York

### **Publications:**

- EL Rosen, R Buonsanti, A Llordes, AM Sawvel, DJ Milliron, BA Helms\*, "Exceptionally mild reactive stripping of native ligands from nanocrystal surfaces using Meerwein's salt," *Angew. Chem. Int. Ed.* **51**(2012), 684.
- RY Wang, R Tangirala, S Raoux, JL Jordan-Sweet, DJ Milliron\*, "Ionic and electronic transport in Ag<sub>2</sub>S nanocrystal – GeS<sub>2</sub> matrix composites with size-controlled Ag<sub>2</sub>S nanocrystals," *Adv. Mater.* **24** (2012), 99.
- R Buonsanti, A Llordes, S Aloni, BA Helms, DJ Milliron\*, "Tunable infrared absorption and visible transparency of colloidal aluminum-doped zinc oxide nanocrystals," *Nano Lett.* **11** (2011), 4706.
- G Garcia, R Buonsanti, EL Runnerstrom, RJ Mendelsberg, A Llordes, A Anders, TJ Richardson, DJ Milliron\*, "Dynamically modulating the surface plasmon resonance of doped semiconductor nanocrystals," *Nano Lett.* **11** (2011), 4415. *Highlighted by Science Editors' Choice.*
- A Llodes, AT Hammack, R Buonsanti, R Tangirala, S Aloni, BA Helms, DJ Milliron\*, "Polyoxometalates and colloidal nanocrystals as building blocks for metal oxide nanocomposite films," *J. Mater. Chem.* **21** (2011), 11631. *Invited for special issue on Chemical Transformations of Nanoparticles.*
- RY Wang, MA Caldwell, RGD Jeyasingh, S Aloni, RM Shelby, HSP Wong, and DJ Milliron\*, "Electronic and Optical Switching of Solution-Phase Deposited SnSe<sub>2</sub> Phase Change Memory Material," *J. Appl. Phys.* **109** (2011), 113506.
- RJ Mendelsberg, SHN Lim, YK Zhu, J Wallig, DJ Milliron, A Anders\*, "Achieving high mobility ZnO:Al at very high growth rates by dc filtered cathodic arc deposition," *J. Phys. D,* **44** (2011), 232003.
- MJ Polking, JJ Urban, DJ Milliron, H Zheng, E Chan, MA Caldwell, S Raoux, CF Kisielowski, JW Ager, R Ramesh\*, and AP Alivisatos\*, "Size-Dependent Polar Ordering in Colloidal GeTe Nanocrystals," *Nano Lett.* **11** (2011), 1147.
- MA Caldwell, AE Albers, SC Levy, TE Pick, BE Cohen, BA Helms\*, DJ Milliron\*, "Driving oxygen coordinated ligand exchange at nanocrystal surfaces using trialkylsilylated chalcogenides," *Chem Commun.* **47** (2011), 556. *Invited for special issue on Emerging Investigators.*
- MA Caldwell, B Haynor, S Aloni, DF Ogletree, HSP Wong, JJ Urban\*, DJ Milliron\*, "Spectroscopic

- Evidence for Exceptional Thermal Contribution to Electron-Beam Induced Fragmentation," *J. Phys. Chem. C* **114** (2010), 22064.
- Q Dai, M Lam, S Swanson, R-HR Yu, DJ Milliron, T Topuria, P-O Jubert\*, A Nelson\*, "Monodisperse cobalt ferrite nanomagnets with uniform silica coatings," *Langmuir* **26** (2010), 17546.
  - EM Chan, C Xu, AW Mao, G Han, JS Owen, BE Cohen, DJ Milliron\*, "Reproducible, high-throughput synthesis of colloidal nanocrystals for optimization in multidimensional parameter space," *Nano Lett.* **10** (2010), 1874. *Highlighted by Materials Today and Nanotechnology Alert.*
  - R Tangirala, JL Baker, AP Alivisatos, DJ Milliron\*, "Modular inorganic nanocomposites by conversion of nanocrystal superlattices," *Angew. Chem. Int. Ed.* **49** (2010), 2878. *Highlighted by Chem. Eng. Prog.*
  - RY Wang, J Feser, X Gu, KM Yu, RA Segalman, A Majumdar, DJ Milliron\*, JJ Urban\*, "A Universal and Solution-Processable Precursor to Bismuth Chalcogenide Thermoelectrics," *Chem. Mater.* **22** (2010), 1943.
  - MA Caldwell, S Raoux, RY Wang, HSP Wong\*, DJ Milliron\*, "Synthesis and size-dependent crystallization of colloidal germanium telluride nanoparticles," *J. Mater. Chem.* **20** (2010), 1285. *Invited for special issue on Emerging Investigators.*
  - HR Moon, JJ Urban, DJ Milliron\*, "Size-controlled synthesis and optical properties of monodisperse colloidal magnesium oxide nanocrystals," *Angew. Chem. Int. Ed.* **48** (2009), 6278. *Selected by the editor as a "hot paper;" highlighted by Photonics Spectra.*
  - S Wu, G Han, DJ Milliron, S Aloni, V Altoe, DV Talapin, BE Cohen\*, PJ Schuck\*, , "Non-blinking and photostable upconverted luminescence from single lanthanide-doped nanocrystals," *Proc. Natl. Acad. Sci.* **106** (2009), 10917.
  - DJ Milliron\*, Q Huang, Y Zhu, "Novel Deposition Methods," in *Phase Change Materials: Science and Applications*, S Raoux and M Wuttig, Eds. Springer, 2009.
  - Y Zhang, S Raoux, D Krebs, LE Krupp, T Topuria, MA Caldwell, DJ Milliron, A Kellock, PM Rice, JL Jordan-Sweet, HSP Wong\*, "Phase change nanodots patterned using a self-assembled polymer lithography and crystallization analysis," *J. Appl. Phys.* **7** (2008), 074312.
  - DJ Milliron\*, MA Caldwell, HSP Wong, "Synthesis of metal chalcogenide nanodot arrays using block copolymer-derived nanoreactors," *Nano Lett* **7** (2007), 3504-3507.
  - Y Zhang, HSP Wong\*, S Raoux, JN Cha, CT Rettner, LE Krupp, T Topuria, DJ Milliron, PM Rice, JL Jordan-Sweet, "Phase change nanodot arrays fabricated using a self-assembly diblock copolymer approach," *Appl Phys Lett* **91** (2007), 013104.
  - DJ Milliron\*, S Raoux, RM Shelby, J Jordan-Sweet, "Solution-phase deposition and nanopatterning of GeSbSe phase change materials," *Nature Mater.* **6** (2007), 352.
  - DJ Milliron\*, DB Mitzi, M Copel, CE Murray, "Solution-processed metal chalcogenide films for p-type transistors," *Chem. Mater.* **18** (2006), 587.
  - P Peng, DJ Milliron, SM Hughes, JC Johnson, AP Alivisatos, RJ Saykally\*, "Femtosecond spectroscopy of carrier relaxation dynamics in type II CdSe/CdTe tetrapod heteronanostructures," *Nano Lett.* **5** (2005), 587.
  - DJ Milliron, I Gur, AP Alivisatos\*, "Hybrid organic-nanocrystal solar cells," *MRS Bull.* **30** (2005), 41.
  - DJ Milliron, SM Hughes, Y Cui, L Manna, J Li, LW Wang, AP Alivisatos\*, "Colloidal nanocrystal heterostructures with linear and branched topology," *Nature* **430** (2004), 190.
  - L Manna, DJ Milliron, A Meisel, EC Scher, AP Alivisatos\*, "Controlled growth of tetrapod-branched inorganic nanocrystals," *Nature Mater.* **2** (2003), 382.
  - WU Huynh, JJ Dittmer, N Teclamariam, DJ Milliron, AP Alivisatos\*, KWJ Barnham, "Charge transport in hybrid nanorod-polymer composite photovoltaic cells," *Phys. Rev. B* **67** (2003), 115316.
  - DJ Milliron, C Pitois, C Edder, AP Alivisatos\*, JMJ Fréchet\*, "Electroactive surfactant designed to mediate charge transfer between CdSe nanocrystals and organic semiconductors," *Adv. Mater.* **15** (2003), 58.
  - A Striolo, J Ward, JM Prausnitz, WJ Parak, D Zanchet, D Gerion, D Milliron, AP Alivisatos\*, "Molecular weight, osmotic second virial coefficient, and extinction coefficient of colloidal CdSe nanocrystals," *J. Phys. Chem. B* **106** (2002), 5500.

- J Schwartz\*, ES Gawalt, G Lu, DJ Milliron KL Purvis, SJ Woodson, SL Bernasek, AB Bocarsly, SK VanderKam, "Organometallic chemistry at the interface with materials science," *Polyhedron* **19** (2000), 505.
- DJ Milliron, IG Hill, A Kahn, J Schwartz\*, "Surface oxidation activates indium tin oxide for hole injection," *J. Appl. Phys.* **87** (2000), 572.
- IG Hill, D Milliron, J Schwartz, A Kahn\*, "Organic semiconductor interfaces: Electronic structure and transport properties," *Appl. Surf. Sci.* **166** (2000), 354.
- JP Chen, G Klaerner, JI Lee, D Markiewicz, VY Lee, RD Miller, JC Scott\*, "Efficient, blue light-emitting diodes using crosslinked layers of polymeric arylamine and fluorene," *Synth. Met.* **107** (1999), 129.
- JP Chen, D Markiewicz, VY Lee, G Klaerner, RD Miller, JC Scott\*, "Improved efficiencies of light-emitting diodes through incorporation of charge transporting components in tri-block polymers," *Synth. Met.* (1999) **107**, 203.
- G Klaerner, JI Lee, VY Lee, E Chan, JP Chen, A Nelson, D Markiewicz, R Siemens, JC Scott, RD Miller\*, "Cross-linkable polymers based on dialkylfluorenes," *Chem. Mater.* **11** (1999), 1800.
- ME Hawley\*, GW Brown, DJ Markiewicz, F Spaepen, EP Barth, "Magnetic force microscopy observation of the magnetic structure of deformation induced shear bands in amorphous Fe<sub>80</sub>B<sub>16</sub>Si<sub>4</sub>," *J. Magn. Magn. Mater.* **190** (1998), 89.

#### **Issued Patents:**

- J Hedrick, DJ Milliron, A Nelson, R Pratt, "Method for forming and aligning chemically mediated dispersion of magnetic nanoparticles in a polymer," US7854878, 2010.
- AP Alivisatos, JJ Dittmer, WU Huynh, DJ Milliron, "Semiconductor-nanocrystal/conjugated polymer thin films," US7777303, 2010.
- MA Caldwell, DJ Milliron, "Inorganic metal chalcogen cluster precursors and methods for forming colloidal metal chalcogenide nanoparticles using the same," US7670584, 2010.
- MA Caldwell, DJ Milliron, "Inorganic metal chalcogen cluster precursors and methods for forming colloidal metal chalcogenide nanoparticles using the same," US7563430, 2009.
- DJ Milliron, DB Mitzi, "Solution deposition of chalcogenide films containing transition metals," US7341917, 2008.
- AP Alivisatos, D Milliron, L Manna, SM Hughes, "Nanocrystals with linear and branched topology," US7303628, 2007.

#### **Pending Patent Applications:**

- DJ Milliron, R Buonsanti, "Colloidal Infrared Reflective and Transparent Conductive Aluminum-Doped Zinc Oxide Nanocrystals," 2011.
- DJ Milliron, G Garcia, A Llordes, R Tangirala, R Buonsanti, "Nanostructured transparent conducting oxide electrochromic device," 2011.
- DJ Milliron, A Llordes, R Buonsanti, G Garcia, "Electrochromic nanocomposite films," 2011.
- DJ Milliron, R Tangirala, A Llordes, "Inorganic Nanocomposite and Method of Making Thereof," 2010.
- AP Alivisatos, I Gur, D Milliron, "Nanocrystal solar cells processed from solution," 2009.
- I Gur, D Milliron, AP Alivisatos, H Liu, "Methods of making functionalized nanorods," 2008.
- DJ Milliron, DB Mitzi, S Raoux, R Ruiz, A Schrott, "Method for filling holes with metal chalcogenide material," 2008.

#### **Honors and Awards:**

- DOE Early Career Research Program Awardee (2010-2015)
- Berkeley Lab Spot Award (2011)
- MDV (Mohr Davidow Ventures) Innovators Award (2010)
- LBNL Outstanding Performance Award (2010)
- DOE Outstanding Mentor Award (2010)
- Berkeley Lab Spot Award (2010)
- R&D 100 Award for Nanocrystal Solar Cells (2009)

- E\PCOS Conference, Best Presentation Award (2009)
- MRS Spring Meeting, Best Poster Award (2007)
- Tech Transfer Award, LBNL (2004)
- National Defense Science and Engineering Graduate Fellowship (1999-2002)
- Barry M. Goldwater Scholarship (1997-1999)
- Robert C. Byrd Scholarship (1995-1999)
- National Science Scholars' Program award recipient (1995)
- Calvin Dodd MacCracken Senior Thesis Award (1999) – one of two awarded from 300 eligible
- Robert Thornton McCay Prize in Physical Chemistry (1999) – one of three (class of 40)
- Outstanding Achievement in Materials Science (1999) – only award in Materials Science
- William Foster Memorial Prize in Chemistry (1998) – only award (class of 40)

#### **Synergistic Activities:**

- Scientific Advisory Board, PLANT PV (2011 - )
- Technical Advisory Board, Pacific Light Tech (2011 - )
- Technical Advisory Board, Spectrawatt (2010-2011)
- Scientific Advisory Board, Nanosys (2009-2010)
- MRS/APS committee on Energy Critical Elements (2009-2011)

#### **Professional Memberships:**

- American Chemical Society
- Materials Research Society
- American Physical Society
- Sigma Xi
- Phi Beta Kappa

#### **Research Proposal Review Activities:**

- NSF Division of Materials Research
- NSF Career Award panel
- DOE Basic Energy Sciences
- Proposal Study Panel for Center for Functional Nanomaterials, Brookhaven National Laboratory

#### **Journal Review and Editorial Activities:**

- ACS Combinatorial Science, Editorial Advisory Board (2011 - )
- Science
- Nature Materials
- Angewandte Chemie
- Nano Letters
- ACS Nano
- Advanced Materials
- Advanced Functional Materials
- Chemistry of Materials
- Journal of Materials Chemistry
- Langmuir
- Crystal Growth and Design
- Journal of the American Chemical Society
- Journal of Physical Chemistry

#### **Invited Presentations and Seminars:**

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|---------|---|
| 11.2011 | Marin Science Seminar, San Rafael, California       |
| 10.2011 | ARPA-E, US Department of Energy, Washington, DC     |
| 09.2011 | European Materials Research Society Meeting, Warsaw |
| 08.2011 | American Chemical Society, National Meeting, Denver |

- 07.2011 Gordon Research Conference, Clusters, Nanocrystals, & Nanostructures, Mount Holyoke  
07.2011 Argonne National Laboratory, Center for Nanoscale Materials  
05.2011 LBNL Carbon Cycle 2.0 Seminar, Berkeley  
05.2011 University of California, San Diego, Nanoengineering Department  
04.2011 University of California, Berkeley, EECS Solid State Seminar  
04.2011 California Institute of Technology, Forum on Nanotechnology for Sustainability  
02.2011 University of California, Santa Barbara, MROP  
01.2011 University of California, Berkeley, Haas School of Business Top Tech Program  
09.2010 Istituto Italiano di Tecnologia, Genoa, Italy  
08.2010 LBNL Summer Lecture Series, Berkeley  
06.2010 Crystal Growth West, South Lake Tahoe, California  
05.2010 DNV Materials Forum, Columbus, Ohio  
01.2010 University of California, Berkeley, Haas School of Business Top Tech Program  
01.2010 University of California, Santa Barbara, Materials Department  
09.2009 European Phase Change and Ovonic Science conference, Aachen, Germany, Selected as "Best Presentation."  
06.2009 NSRC contractors meeting, Annapolis, Maryland  
04.2009 MRS Spring Meeting, San Francisco  
01.2009 Oregon State University, Eugene  
10.2008 University of California, Berkeley, Nanoscience seminar series  
09.2008 LBNL The Molecular Foundry  
09.2008 European Phase Change and Ovonic Science conference, Prague  
04.2008 SUNY, Stonybrook, Department of Physics and Astronomy  
04.2008 MRS Spring Meeting, San Francisco  
10.2007 CCNY, New York, Department of Chemistry  
11.2006 Palo Alto Research Center (PARC)  
03.2003 International Symposium on Compound Semiconductors (ISCS), San Diego  
03.2003 Nanoscale Science Reserch Centers Workshop, Washington, DC